

WHAT IS CLAIMED IS:

1. A semiconductor cleaning method, comprising:
providing a semiconductor wafer;
forming a first layer of oxide over the semiconductor wafer;
forming a floating gate layer over the first layer of oxide;
forming a second layer of oxide over the floating gate layer;
etching the first layer of oxide, the floating gate layer, and the second layer of oxide to form a gate structure;
cleaning the semiconductor wafer including the gate structure using an ozonated de-ionized (DI) water;
further cleaning of the ozonated water-cleaned semiconductor wafer using a first cleaning solution; and
additional cleaning of the further cleaned semiconductor wafer using a second cleaning solution.
2. The method of claim 1, wherein the floating gate comprises polysilicon or nitride.
3. The method of claim 1, wherein the semiconductor wafer has formed therein at least one device.

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4. The method of claim 1, wherein the semiconductor wafer has accumulated thereon contaminants accumulated during at least one previous processing step.

5. The method of claim 4, wherein the contaminants comprises polymer.

6. The method of claim 5, wherein the polymer comprises photoresist.

7. The method of claim 1, wherein the first cleaning solution comprises a $\text{H}_2\text{O}:\text{H}_2\text{O}_2:\text{NH}_4\text{OH}$ solution, wherein the proportions of $\text{H}_2\text{O}:\text{H}_2\text{O}_2:\text{NH}_4\text{OH}$ are within the range of 1:1-5:4-80.

8. The method of claim 7, wherein the proportions of $\text{H}_2\text{O}:\text{H}_2\text{O}_2:\text{NH}_4\text{OH}$ are 2.1:3.1:80.

9. The method of claim 1, wherein the first cleaning solution comprises a $\text{H}_2\text{O}:\text{H}_2\text{O}_2:\text{HCl}$ solution, wherein the proportions of $\text{H}_2\text{O}:\text{H}_2\text{O}_2:\text{HCl}$ are within the range of 1:1-5:4-80.

10. The method of claim 9, wherein the proportions of $\text{H}_2\text{O}:\text{H}_2\text{O}_2:\text{HCl}$ are 1.3:2.2:80.

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11. The method of claim 1, wherein the first cleaning solution comprises a HF:HCl:H₂O solution, wherein the proportions of HF:HCl:H₂O are 1:1.3:400.

12. The method of claim 1, wherein the concentration of ozone in the ozonated DI water is within the range of 10-80 ppm.

13. The method of claim 12, wherein the concentration of ozone in the ozonated DI water is 40 ppm.

14. The method of claim 1, wherein the second cleaning solution comprises an ozonated DI water.

15. A semiconductor cleaning method, comprising:

- providing a semiconductor wafer;
- forming a first layer of oxide over the semiconductor wafer;
- forming a floating gate layer over the first layer of oxide;
- forming a second layer of oxide over the floating gate layer;
- forming a layer of nitride over the second layer of oxide;
- forming a third layer of oxide over the layer of nitride;
- etching the first layer of oxide, the floating gate layer, the second layer of oxide, the layer of nitride, and the third layer of oxide to form a gate structure;
- cleaning the semiconductor wafer using an ozonated de-ionized (DI) water;
- cleaning the semiconductor wafer using a standard cleaning solution; and

cleaning the semiconductor wafer using an ozonated DI water.

16. The method of claim 15, wherein the floating gate comprises polysilicon or nitride.

17. The method of claim 15, wherein the standard cleaning solution comprises a $\text{H}_2\text{O}:\text{H}_2\text{O}_2:\text{NH}_4\text{OH}$ solution, wherein the proportions of $\text{H}_2\text{O}:\text{H}_2\text{O}_2:\text{NH}_4\text{OH}$ are within the range of 1:1-5:4-80.

18. The method of claim 15, wherein the first cleaning solution comprises a $\text{H}_2\text{O}:\text{H}_2\text{O}_2:\text{HCl}$ solution, wherein the proportions of $\text{H}_2\text{O}:\text{H}_2\text{O}_2:\text{HCl}$ are within the range of 1:1-5:4-80.

19. A semiconductor cleaning method, comprising:

- providing a semiconductor wafer;
- forming a first layer of oxide over the semiconductor wafer;
- forming a floating gate layer over the first layer of oxide;
- forming a second layer of oxide over the floating gate layer;
- forming a layer of nitride over the second layer of oxide;
- forming a third layer of oxide over the layer of nitride;
- etching the first layer of oxide, the floating gate layer, the second layer of oxide, the layer of nitride, and the third layer of oxide to form a gate structure;
- cleaning the semiconductor wafer using an ozonated de-ionized (DI) water;

cleaning the semiconductor wafer using an HF:HCl:H₂O solution; and
cleaning the semiconductor wafer using an ozonated DI water.

20. The method of claim 19, wherein the proportions of HF:HCl:H₂O in the
HF:HCl:H₂O solution are 1:1.3:400.

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